

## 1.0 INTRODUCTION

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting their designated uses even though pollutant sources have implemented technology-based controls. A TMDL establishes the allowable load of a pollutant or other quantifiable parameter based on the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of the state's water resources (USEPA, 1991).

As a result of water quality and biological investigations conducted by the Pennsylvania Department of Environmental Protection (PADEP) and Delaware Department of Natural Resources and Environmental Control (DNREC) that identified observed impacts on aquatic life, many streams in the Christina River Basin have been listed on the States' 303(d) lists of impaired waters. Parts of the watershed are heavily impacted by urbanization and are listed as impaired due to problems associated with elevated nutrient levels, including low dissolved oxygen (DO). This study, in conjunction with the low-flow Christina TMDL (USEPA, 2002), will fulfill the requirements for nutrient and low dissolved oxygen TMDL development for waters in the Christina River basin included in the 303(d) lists for Pennsylvania and Delaware. A related study is underway to address impairments resulting from elevated bacteria and sediment loads. These studies will address the impairments through either direct TMDL development or additional monitoring to determine if recent changes in management practices have resulted in improved water quality conditions and subsequent removal of the stream segments from the 303(d) list.

### 1.1 Historical Perspective

In 1991, at the request of DNREC and PADEP, the Delaware River Basin Commission (DRBC) agreed to mediate water management issues in the "interstate" Christina River Basin. The issues included interstate and intrastate coordination of monitoring, modeling, and pollution controls; balancing the conflicting demands for potable water while maintaining necessary minimum pass-by requirements to sustain aquatic life; protection of vulnerable, high quality scenic and recreational areas; restoration of wetlands and other critical habitats; and implementation of Delaware's Exceptional Recreational or Ecological Significance (ERES) objectives. A comprehensive basin approach was needed to address these management issues.

The DRBC facilitated a series of meetings with DNREC, PADEP, EPA, Chester County Water Resources Authority (CCWA) and the United States Geological Survey (USGS). EPA funded a study by Scientific Applications International Corporation (SAIC) for completion of an initial data assessment and problem identification study for the non-tidal portion of Brandywine Creek. The findings of this study, *Preliminary Study of the Brandywine Creek Sub-basin, Final Report, September 30, 1993*, provided a framework for use in a multi-step TMDL study for the entire Christina River Basin. The two states, DRBC and EPA, reached agreement in late 1993 to initiate a cooperative and coordinated monitoring and modeling approach to produce Christina River Basin TMDLs under low-flow conditions.

Even as the parties reached agreement on how best to address the impacts of pollutants during low-flow conditions, they recognized that additional efforts would be necessary to address the distinct water quality problems resulting from primarily nonpoint sources of pollutants during high-flow conditions. In 1993, EPA recommended that DRBC expand the effort to consider high-flow conditions. As a result, the Christina Basin Water Quality Management Committee (CBWQMC) was created with the purpose of addressing the applicable water quality problems and management policies on a watershed scale. The CBWQMC represents a variety of stakeholders and interested parties including the Brandywine Valley Association/Red Clay Valley Association (BVA/RCVA), Chester County Conservation District (CCCD), Chester County Health Department (CCHD), Chester County Planning Commission (CCPC), CCWA, DNREC, Delaware Nature Society (DNS), DRBC, New Castle County Conservation District (NCCD), DEP, EPA Region III, USGS, United States Natural Resources Conservation Service (USDA-NRCS) and the Water Resources Agency for New Castle County (WRANCC).

The CBWQMC developed a unified, multi-phased, 5-year Water Quality Management Strategy (WQMS) that first addresses the water quality problems through voluntary watershed/water quality planning and management activities and second, establishes appropriate TMDLs. The reason for separating the development of TMDLs to address water quality problems between low-flow and high-flow TMDLs is that each scenario has different and distinct pollutants and problems at different flow regimes.

Since 1995, the CBWQMC has been conducting activities set forth in the WQMS designed to implement programs aimed at protecting and improving water quality. These activities include Geographic Information System (GIS) watershed inventory, water quality assessment, watershed pollutant potential and prioritization, stormwater monitoring, Best Management Practices (BMP) Implementation projects and public education/outreach. A summary of these activities can be found in *Phase I and II Report, Christina River Basin Water Quality Management Strategy, May 1998* and *Phase III Report, Christina Basin Water Quality Management Strategy, August 5, 1999*. These reports describe ongoing efforts to provide pollution control and restore water quality within the Christina River Basin.

Both Pennsylvania and Delaware have identified multiple segments and pollutants in the Christina River Basin on their respective lists of impaired waters requiring the development of a TMDL. The Clean Water Act (CWA) requires that upstream waters must meet the applicable WQS of the downstream state at or before the state line. In other words, a TMDL in the Christina River Basin in Delaware requires Pennsylvania waters to meet Delaware's WQS at the state line.

Concurrent with the water quality improvement activities taking place within the Christina River Basin, EPA settled two civil lawsuits regarding EPA's oversight of the TMDL programs of Pennsylvania and Delaware. Both suits alleged violations of the CWA, the Endangered Species Act (ESA) and the Administrative Procedures Act (APA). The settlement of the Pennsylvania matter, American Littoral Society and the Public Interest Research Group v. EPA, Civil No. 96-489 (E.D. Pa), was entered on April 9, 1997. The Pennsylvania TMDL settlement requires certain numbers of TMDLs by certain dates but gives discretion to Pennsylvania and EPA as to which TMDLs must be completed. The settlement of the Delaware lawsuit, American Littoral Society and Sierra Club v. EPA, Civil Action No. 96-591 (SLR) (D.De), was entered on August 9, 1997. The Delaware TMDL settlement sets forth specific deadlines for EPA relating to

specific waters and TMDLs in the Christina River Basin. Under the schedule set forth in the settlement, Delaware was to establish low-flow TMDLs for all water quality limited segments (except for those impaired by bacteria), including Brandywine Creek, Christina River, Red Clay Creek and White Clay Creek, by December 31, 1999. The Delaware settlement also expects Delaware to establish high-flow TMDLs by December 31, 2004. Pursuant to the Delaware agreement, EPA is required to establish TMDLs within one year should Delaware fail to do so.

## 1.2 Background Information

In addition to the legal, statutory and regulatory requirements of identifying water quality limited segments and establishing TMDLs, there are several compelling reasons why establishing these TMDLs is good public policy in that they: (1) protect water quality uses, (2) protect sources of drinking water, and (3) promote appropriate growth. One goal of the CWA, and other similar legislation, is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. These critical, but often delicate, natural resources can be easily degraded by anthropogenic and other sources of pollution. Polluted waters can affect the quality of life, health and vitality of citizens in the Christina River Basin. Consistent with the goals of the CWA, it is in the public interest to sustain the diverse human, ecological, aesthetic and recreational resources of the watershed.

The Christina River Basin is composed of diverse land uses including urban, rural and agricultural areas. Urban areas in the watershed include greater Wilmington and Newark, Delaware, and the Pennsylvania towns of West Chester, Downingtown, Kennett Square, Coatesville, Parkesburg, Honey Brook, Avondale and West Grove. The land use distribution within the basin is summarized in Table 1-1.

The Christina River Basin (Hydrologic Unit Code 02040205) covers an area of about 565 square miles and is located in Chester County, Pennsylvania, New Castle County, Delaware, and Cecil County, Maryland (see Figure 1-1 and Table 1-2). Major streams include the Christina River (tidal and nontidal), Brandywine Creek (tidal and nontidal), Red Clay Creek and White Clay Creek (tidal and nontidal). These streams are used as habitat for aquatic life, for municipal and industrial water supplies and for recreational purposes. The Christina River Basin drains to the tidal Delaware River at Wilmington, Delaware.

**Table 1-1. Christina River Basin land use summary (square miles)**

Land Use	DE/MD	Pennsylvania	Total	%
Urban/Suburban	87	108	195	34
Agricultural	18	160	178	31
Open Space or Protected Lands	21	5	26	5
Wooded	37	123	160	28
Water/other	3	3	6	2
Total	166	399	565	100

Source: Phase I/II Report Christina River Basin Water Quality Management Strategy (CBWQMC - May 1998)

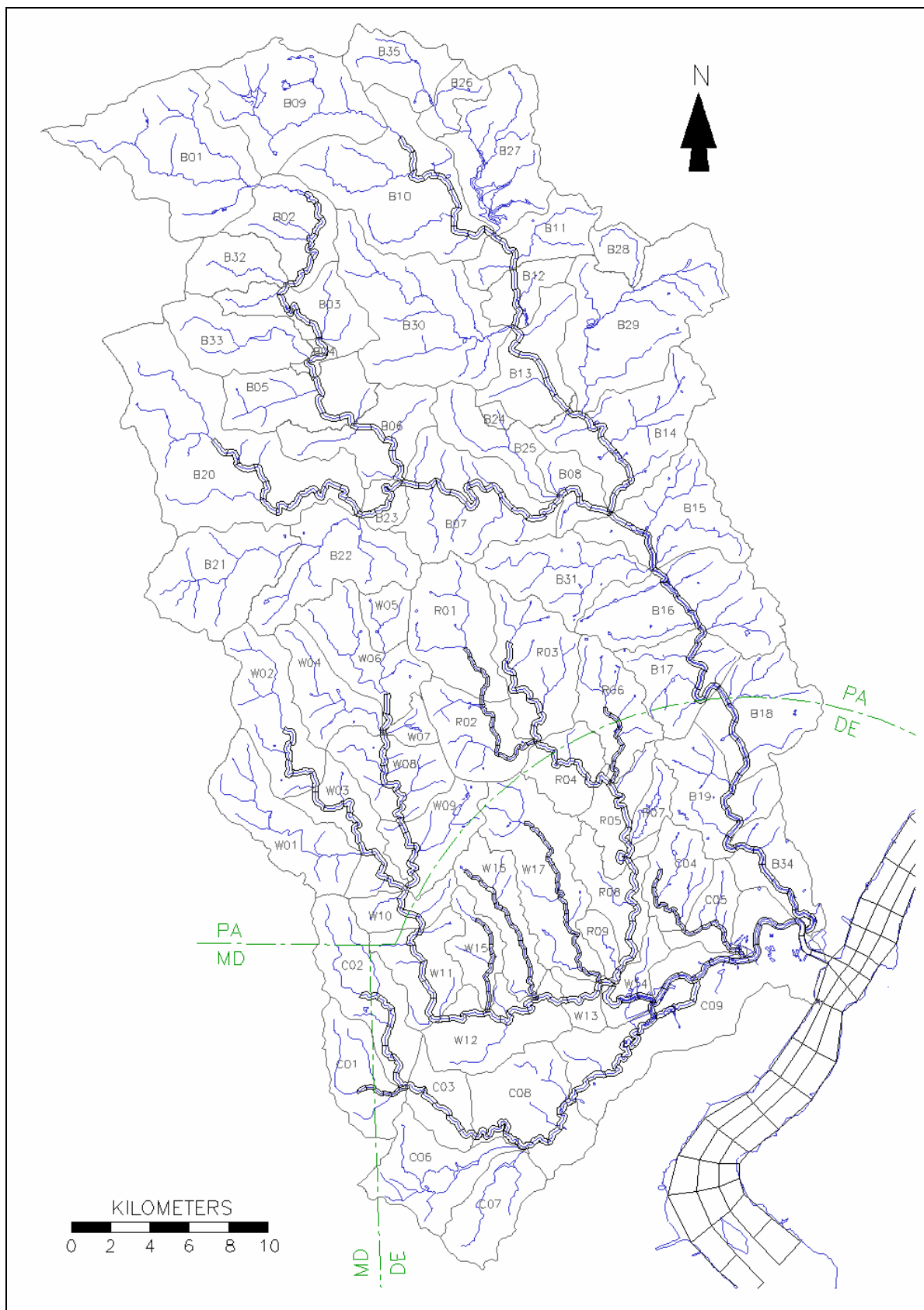


Figure 1-1. Christina River Basin delineation of HSPF model subbasins and EFDC model grid

**Table 1-2. Subbasins in the HSPF models of Christina River Basin**

Subbasin	Stream Name	Area (sq.mi)	Subbasin	Stream Name	Area (sq.mi)
<i>Brandywine Creek Watershed</i>			<i>White Clay Creek Watershed</i>		
B01	Upper Brandywine Creek West Br.	18.39	W01	White Clay Creek West Br.	10.23
B02	Brandywine Creek West Branch	7.38	W02	Upper White Clay Creek Middle Br.	9.51
B03	Brandywine Creek West Branch	6.76	W03	White Clay Creek Middle Br.	6.35
B04	Brandywine Creek West Branch	0.80	W04	Trib. to White Clay Creek East Br.	6.20
B05	Brandywine Creek West Branch	8.82	W05	Trib. to White Clay Creek East Br.	2.65
B06	Brandywine Creek West Branch	8.06	W06	Upper White Clay Creek East Br.	8.57
B07	Brandywine Creek West Branch	13.46	W07	Trout Run	1.37
B08	Brandywine Creek West Branch	3.62	W08	White Clay Creek East Branch	7.47
B09	Upper Brandywine Creek East Br.	14.68	W09	White Clay Creek East Branch	6.85
B10	Brandywine Creek East Branch	18.31	W10	White Clay Creek	3.58
B11	Brandywine Creek East Branch	6.31	W11	White Clay Creek	6.53
B12	Brandywine Creek East Branch	3.70	W12	White Clay Creek	8.76
B13	Brandywine Creek East Branch	7.94	W13	White Clay Creek	2.08
B14	Brandywine Creek East Branch	12.92	W14	White Clay Creek	3.41
B15	Brandywine Creek	10.36	W15	Muddy Run	3.89
B16	Brandywine Creek	14.06	W16	Pike Creek	6.65
B17	Brandywine Creek	7.51	W17	Mill Creek	13.00
B18	Brandywine Creek	10.37	<i>Red Clay Creek Watershed</i>		
B19	Brandywine Creek	8.64	R01	Upper Red Clay Creek West Branch	10.08
B20	Upper Buck Run	25.54	R02	Red Clay Creek West Branch	7.39
B21	Upper Doe Run	11.05	R03	Red Clay Creek East Branch	9.90
B22	Lower Doe Run	10.96	R04	Red Clay Creek	5.11
B23	Lower Buck Run	1.95	R05	Red Clay Creek	5.24
B24	Tributary to Broad Run	0.60	R06	Burroughs Run	7.10
B25	Broad Run	5.83	R07	Hoopers Reservoir	2.10
B26	Marsh Creek	2.61	R08	Red Clay Creek	5.38
B27	Marsh Creek	11.54	R09	Red Clay Creek	1.72
B28	Tributary to Valley Creek	2.40	<i>Christina River Watershed</i>		
B29	Valley Creek	18.21	C01	Christina River West Branch	6.70
B30	Beaver Creek	18.08	C02	Upper Christina River	9.73
B31	Pocopson Creek	9.19	C03	Christina River	4.47
B32	Birch Run	4.66	C04	Upper Little Mill Creek	5.37
B33	Rock Run	8.03	C05	Lower Little Mill Creek	3.84
B34	Lower Brandywine Creek	6.05	C06	Muddy Run	8.64
B35	Upper Marsh Creek	5.80	C07	Belltown Run	6.37
			C08	Christina River	10.70
			C09	Lower Christina River (tidal)	21.90

In addition to the legal, statutory and regulatory requirements of identifying water quality limited segments and establishing TMDLs, there are several compelling reasons why establishing these TMDLs is good public policy to address the water quality of the Christina River Basin: (1) protect water quality uses, (2) protect sources of drinking water, and (3) promote appropriate growth. One goal of the CWA, and other similar legislation, is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. These critical, but often delicate, natural resources can be easily degraded by anthropogenic and other sources of pollution. Polluted waters can affect the quality of life, health and vitality of citizens in the Christina River Basin. Consistent with the goals of the CWA, it is in the public interest to sustain the diverse human, ecological, aesthetic and recreational resources of the watershed.

### **1.3 Impairment Listing**

In response to the requirements of Section 303(d) of the CWA, PADEP and DNREC listed multiple Christina River Basin waterbodies on the 1996 and 1998 303(d) lists of impaired waterbodies based on available information. Pennsylvania identified a total of 60 stream segments as impaired by nutrients, organic enrichment, or low dissolved oxygen. Of that total, 14 stream segments were first listed in 1996 and 46 stream segments were listed in 1998 (Table 1-3). Delaware identified 15 stream segments on the 1998 303(d) list (Table 1-4) as not meeting WQS for nutrients and low DO within the Christina River Basin. Pursuant to the TMDL Consent Decree in Delaware, those 15 stream segments were given high priority. Likewise, Pennsylvania identified 23 of the listed segments as high priority. A number of monitoring stations are located throughout the Christina River Basin within the listed waters. Data from these stations as well as biological assessments were used to determine the impairment and inclusion on the 303(d) lists. Excessive nutrients, organic enrichment and low DO are specified as the causes of impairment in the various listed stream segments. The pollutant sources are varied and include industrial and municipal point sources, agriculture, Superfund sites and hydro modification.

**Table 1-3. Christina River Basin stream segments on the PA 1998 303(d) List**

Watershed	Stream ID	Segment ID	Miles	Year Listed	Source of Impairment	Cause of Impairment	HSPF Subbasin
Trib to Brandywine Cr.	00026	27	1.3	1996	Other	Nutrients	B17
East Br. Brandywine Cr.	64954	970707-120-HLW	1.1	1996	Agriculture	Nutrients	B09
East Br. Brandywine Cr.	00229	970703-1500-ACE	0.6	1996	Agriculture	Nutrients	B09
East Br. Brandywine Cr.	00229	970707-1120-GLW	2.9	1996	Agriculture	Nutrients	B09
East Br. Brandywine Cr.	00371	970707-1120-GLW	1.5	1996	Agriculture	Nutrients	B09
E.Br. Brandywine Cr.	00372	970707-1120-GLW	0.7	1996	Agriculture	Nutrients	B09
Indian Run	00360	360	3.3	1996	Agriculture, hydromodification	Nutrients, low DO, organic enrichment	B10
Sucker Run	00202	970930-1437-GLW	3.6	1998	Agriculture	Nutrients	B05
Sucker Run	00203	970930-1437-GLW	1.6	1998	Agriculture	Nutrients	B05
Sucker Run	00204	970930-1437-GLW	0.9	1998	Agriculture	Nutrients	B05
Sucker Run	00205	970930-1437-GLW	0.7	1998	Agriculture	Nutrients	B05
West Br. Brandywine Cr.	00085	9700925-1348-GLW	4.7	1996	Agriculture	Nutrients	B04, B05, B06
West Br. Brandywine Cr.	00085	970618-1118-GLW	3.0	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00085	970618-1340-GLW	1.5	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00224	970619-1222-GLW	4.6	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00224	970619-1345-GLW	2.6	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00225	970619-1322-GLW	0.9	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00226	970619-1345-GLW	1.4	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00227	970618-1340-GLW	1.3	1998	Agriculture	Nutrients	B01
West Br. Brandywine Cr.	00228	970618-1340-GLW	0.8	1998	Agriculture	Nutrients	B01
Broad Run	00434	971209-1445-ACW	3.2	1998	Agriculture, hydromodification	Nutrients, low DO, organic enrichment	W09
Broad Run	00436	971209-1445-ACW	0.8	1998	Agriculture, hydromodification	Nutrients, low DO, organic enrichment	W09
East Br. Red Clay Cr.	00413	971023-1050-MRB	5.3	1996	Agriculture	Organic enrichment, low DO	R03
East Br. Red Clay Cr.	00418	971204-1400-ACW	0.8	1998	Agriculture	Organic enrichment, low DO	R03
East Br. Red Clay Cr.	00419	971023-1050-MRB	1.2	1996	Agriculture	Organic enrichment, low DO	R03
East Br. White Clay Cr.	00432	971113-1335-GLW	3.1	1998	Agriculture	Organic enrichment, low DO	W09
East Br. White Clay Cr.	00432	970506-1320-MRB	2.7	1998	Agriculture	Nutrients	W08
East Br. White Clay Cr.	00432	9417	2.0	1996	Municipal PS	Nutrients, low DO, organic enrichment	W08
East Br. White Clay Cr.	00432	971119-1116-GLW	1.2	1998	Agriculture	Organic enrichment, low DO	W06
East Br. White Clay Cr.	00438	970506-1320-MRB	0.6	1998	Agriculture	Nutrients	W08
East Br. White Clay Cr.	00439	970506-1320-MRB	0.7	1998	Agriculture	Nutrients	W08
East Br. White Clay Cr.	00443	970506-1320-MRB	0.7	1998	Agriculture	Nutrients	W08
East Br. White Clay Cr.	00444	970506-1320-MRB	0.7	1998	Agriculture	Nutrients	W08
E.Br. White Clay Cr.	00445	970508-1430-ACE	2.4	1998	Agriculture	Organic enrichment, low DO	W08
East Br. White Clay Cr.	00446	970506-1320-MRB	0.5	1998	Agriculture	Nutrients	W08
East Br. White Clay Cr.	00447	970506-1320-MRB	0.8	1998	Agriculture	Nutrients	W06
East Br. White Clay Cr.	00448	970409-1130-MRB	0.8	1998	Agriculture	Nutrients	W04

Watershed	Stream ID	Segment ID	Miles	Year Listed	Source of Impairment	Cause of Impairment	HSPF Subbasin
East Br. White Clay Cr.	00454	971120-1331-GLW	5.4	1998	Agriculture	Nutrients	W06
East Br. White Clay Cr.	00455	971120-1331-GLW	2.5	1998	Agriculture	Nutrients	W06
East Br. White Clay Cr.	00456	971120-1331-GLW	0.2	1998	Agriculture	Nutrients	W06
Egypt Run	00440	970508-1245-ACE	1.5	1998	Agriculture	Nutrients, low DO, organic enrichment	W08
Egypt Run	00441	970508-1245-ACE	1.4	1998	Agriculture	Nutrients, low DO, organic enrichment	W08
Egypt Run	00442	970508-1245-ACE	0.8	1998	Agriculture	Nutrients, low DO, organic enrichment	W08
Indian Run	00475	115	1.1	1998	Agriculture	Nutrients	W03
Middle Br. White Clay Cr.	00462	115	9.3	1998	Agriculture	Nutrients	W02, W03
Middle Br. White Clay Cr.	00462	115B	2.2	1996	Agriculture, Municipal PS	Nutrients	W02
Middle Br. White Clay Cr.	00476	115	1.6	1998	Agriculture	Nutrients	W02
Middle Br. White Clay Cr.	00477	115	1.8	1998	Agriculture	Nutrients	W02
Middle Br. White Clay Cr.	00478	115	1.3	1998	Agriculture	Nutrients	W02
Middle Br. White Clay Cr.	00479	115	0.6	1998	Agriculture	Nutrients	W02
Middle Br. White Clay Cr.	00480	115	0.6	1998	Agriculture	Nutrients	W02
Red Clay Creek	00374	971203-1400-ACW	0.1	1998	Agriculture	Organic enrichment, low DO	R04
Trout Run	63874	970506-1425-MRB	1.7	1998	Agriculture	Nutrients	W07
Trout Run	63875	970506-1425-MRB	0.8	1998	Agriculture	Nutrients	W07
Trout Run	63876	970506-1425-MRB	0.2	1998	Agriculture	Nutrients	W07
Walnut Run	00435	971209-1445-ACW	1.4	1998	Agriculture, hydromodification	Nutrients, low DO, organic enrichment	W09
West Br. Red Clay Cr.	00391	971023-1145-MRB	4.6	1998	Agriculture	Organic enrichment, low DO	R02
West Br. Red Clay Cr.	00396	971023-1315-MRB	1.8	1996	Agriculture	Nutrients	R02
West Br. White Clay Cr.	00465	9408	7.8	1996	Agriculture	Nutrients	W01
White Clay Creek	00373	971216-1230-GLW	1.4	1998	Agriculture	Nutrients	W10



**Table 1-4. Christina River Basin stream segments on the DE 1998 303(d) List**

Waterbody ID	Watershed Name	Segment	Miles	Year Listed	Pollutants/Stressor	Probable Sources	HSPF Subbasin
DE040-001	Brandywine Creek	Lower Brandywine	3.8	1996	nutrients	PS, NPS, SF	B34
DE040-002	Brandywine Creek	Upper Brandywine	9.3	1996	nutrients	PS, NPS, SF	B18, B19
DE260-001	Red Clay Creek	Main Stem	12.8	1996	nutrients	PS, NPS, SF	R04, R05, R08, R09
DE260-002	Red Clay Creek	Burroughs Run	4.5	1996	nutrients	NPS	R06
DE320-001	White Clay Creek	Main Stem	18.2	1996	nutrients	PS, NPS	W10, W11, W12, W13, W14
DE320-002	White Clay Creek	Mill Creek	16.6	1996	nutrients	NPS	W17
DE320-003	White Clay Creek	Pike Creek	9.4	1996	nutrients	NPS	W16
DE320-004	White Clay Creek	Muddy Run	5.8	1996	nutrients	NPS	W15
DE120-001	Christina River	Lower Christina	1.5	1996	nutrients, DO	NPS, SF	C09
DE120-002	Christina River	Middle Christina River	7.5	1996	nutrients	NPS, SF	C09
DE120-003	Christina River	Upper Christina River	6.3	1996	nutrients	NPS, SF	C09
DE120-003-02	Christina River	Lower Christina Creek	8.4	1996	nutrients	NPS	C03, C08
DE120-005-01	Christina River	West Branch	5.3	1996	nutrients	NPS	C01
DE120-006	Christina River	Upper Christina Creek	8.3	1996	nutrients	NPS	C02
DE120-007-01	Christina River	Little Mill Creek	12.8	1996	nutrients, DO	NPS, SF	C04, C05

PS= point source; NPS = nonpoint source; SF=superfund site

## 1.4 Water Quality Standards

The CWA requires states to adopt WQS to define the water goals for a waterbody by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses and by protecting water quality through antidegradation provisions. These standards serve dual purposes: they establish water quality goals for a specific waterbody, and they serve as the regulatory basis for establishing water quality-based controls and strategies beyond the technology-based levels of treatment required by sections 301(b) and 306 of the CWA. Within the Christina River Basin, there are four regulatory agencies that have applicable WQS. The PADEP, DNREC, and MDE have WQS that apply to those stream segments of the Christina River Basin located in the respective state. The DRBC is an interstate agency that has the authority to establish WQS and regulate pollution activities within the Delaware River Basin including the Christina River Basin, one of the Delaware River's tributary basins. Tables 1-5 and 1-6 below summarize the applicable WQS relating to DO and nutrients.

### 1.4.1 Pennsylvania WQS

Pennsylvania Code, Title 25, Chapter 93 sets forth water quality standards for surface waters of the state. These standards are based upon water uses which are to be protected and will be considered by PADEP in its regulation of discharges. Implementation of the numeric water quality criteria in Pennsylvania are summarized in Table 1-5 and 1-6, and defined in PA Code, Title 25, Chapter 96.3 as follows:

Chapter 96.3(c): “To protect existing and designated surface water uses, the water quality criteria described in Chapter 93 (relating to water quality standards), including the criteria in Chapters 93.7 and 93.8a(b) (relating to specific water quality criteria; and toxic substances) shall be achieved in all surface waters at least 99% of the time, unless otherwise specified in this title. The general water quality criteria in Chapter 93.6 (relating to general water quality criteria) shall be achieved in surface waters at all times at design conditions.”

Chapter 96.3(d): “As an exception to subsection (c), the water quality criteria for total dissolved solids, nitrite-nitrate nitrogen, phenolics and fluoride established for the protection of potable water supply shall be met at least 99% of the time at the point of all existing or planned surface potable water supply withdrawals unless otherwise specified in this title.”

In addition to numeric water quality criteria, waters in the Christina River Basin are also subject to narrative criteria stated in PA Code, Title 25, Chapter 93.6, as follows:

Chapter 93.6(a): “Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life.”

Chapter 93.6(b): “In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances which produce color, tastes, odors, turbidity or settle to form deposits.”

Chapter 93.9(g): Drainage List G contains the designated uses for the waters within the Brandywine Creek, Red Clay Creek, and White Clay Creek watersheds. Protected uses include cold water fishes, warm water fishes, migratory fishes, trout stocking fishes, high quality, and exceptional quality waters.

#### 1.4.2 Delaware WQS

Delaware's water quality criteria for DO and nutrients are listed in Table 1-5 and Table 1-6. Marine waters are defined as waters of the state that contain natural levels of salinity greater than 5 parts per thousand (ppt). All waters within the Christina River Basin have natural salinity levels less than 5 ppt. Therefore, the fresh water designated use shall apply for this TMDL.

**Table 1-5. Summary of applicable use designations and DO criteria**

Agency	Designated Use	D.O. Criteria (mg/L)		Comments
		Daily avg.	Minimum	
PADEP	Warm water fish (WWF)	5.0	4.0	Feb 15 - Jul 31 Aug 01 - Feb 14  Special Protection Waters  Special Protection Waters  Special Protection Waters
	Cold water fish (CWF)	6.0	5.0	
	Trout stocking fishery (TSF)	6.0 5.0	5.0 4.0	
	High Quality CWF		7.0	
	High Quality TSF	6.0	5.0	
	Exceptional value			
DNREC	Fresh waters	5.5	4.0	Year round
	Cold water fish	6.5	5.0	Seasonal
	Marine waters	5.0	4.0	Salinity greater than 5.0 ppt
	Exceptional recreation or ecological significance			Existing or natural water quality
MDE	Fresh waters	5.0	5.0	Use I waters, DO must not be less than 5.0 mg/L at any time
DRBC	Resident game fish	5.0	4.0	During spawning season  6.5 mg/L seasonal average during Apr 01 - Jun 15 and Sep 16 - Dec 31
	Trout	6.0	5.0 7.0	
	Tidal: resident or anadromous fish	4.5		

**Table 1-6. Summary of nutrient criteria**

Parameter	Agency	Comments
<b>Ammonia-Nitrogen*</b>		
	PADEP	1-day and 30-day average ambient criteria are a function of pH and temperature for toxicity; Implementation Guidance document for Ammonia allocations for NBOD and Toxicity.
	DNREC	No specific numeric criteria; Narrative statement for prevention of toxicity.
	DRBC	NPDES effluents limited to a 30-day average of 20 mg/L as N.
<b>Nitrate-Nitrogen</b>		
	PADEP	Ambient criteria is maximum of 10 mg/L as N applied at the point of water supply intake, not at the point of an effluent discharge. For the case of an interstate stream, the state line shall be considered a point of water supply intake.
	DNREC	Ambient nitrate criteria is maximum of 10 mg/L as N; provision for site-specific nutrient controls. The DNREC 303(d) rationale document cites 3.0 mg/L total nitrogen as guidance for determining impairment.
	DRBC	No specific numeric criteria.
<b>Phosphorus</b>		
	PADEP	No specific numeric criteria are specified in the Pennsylvania Code, Title 25, Chapter 93 (Water Quality Standards). According to Chapter 95 (Wastewater Treatment Requirements), phosphorus effluent limits are set to a maximum of 2 mg/L whenever the Department determines that instream phosphorus alone or in combination with other pollutants contributes to impairment of designated stream uses.
	DNREC	No specific numeric criteria; provision for site-specific controls. The 303(d) rationale document cites 0.2 mg/L of total phosphorus as guidance for use impairment.
	DRBC	No specific numerical criteria.

\* Maryland adopted the EPA water quality criteria for ammonia nitrogen in January 2001 (effective April 2001 - Title 26 Maryland Department of the Environment Subtitle 08 Water Pollution Chapter 02 Water Quality). This was approved by EPA in June 2001.